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(54) **Method for impression taking and for production of dental prostheses anchored in the jaw bone**

Verfahren zum Abdrucknehmen und zur Herstellung von Zahnersatz zur Verankerung im Kieferknochen

Procédé pour la prise d'empreintes et pour la fabrication de prothèses dentaires fixées dans l'os maxillaire

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Description

[0001] The present invention relates to a method for increasing the precision of impression-taking and production of dental prostheses of the type which are permanently anchored in the jaw by means of one or more securing elements implanted in the jawbone. Each one of these securing elements is provided with a distance member whose upper part protrudes above the palatal arch and on which the finished dental prosthesis/dental bridge is then anchored via a so-called gold cylinder.

[0002] Dental bridges which are anchored in this way on distance members must be carefully adapted to the actual appearance of the jaw. The way in which this can be done is shown, for example, in Swedish Patent 446371 which describes how a positive working model of a lower or upper jaw provided with protruding distance members of this type can be produced. The impression system which is used there includes components such as impression tops and distance dummies which are fixed with the aid of guide pins.

[0003] A positive working model of the jaw obtained in this way is used by the dental technician for producing the finished dental prosthesis/dental bridge. In this way he does not have to carry out the time-consuming and complicated work involved in adapting the prosthesis directly in the patient's mouth, and instead he works with a model of the patient's jaw. The production of the positive working model is facilitated with the aid of the components included in the impression system, namely the impression tops, distance dummies, gold cylinders and guide pins. The ways in which the various impression components are used are already known per se and will therefore not be described in detail here. However, it will be noted that the impression technique and the production of the model comprise four stages:

- the impression top is placed on the distance member,
- the distance dummy is placed on the impression top,
- the impression top is placed on the gold cylinder,
- the gold cylinder is placed on the distance member.

[0004] In the first three stages a guide pin is used to fix the components to each other, while the gold cylinder is fixed on the distance member with the aid of a gold screw. Since the components always have a certain tolerance deficit, a degree of error is introduced during each of the four stages. The errors add up and can lead to stresses being built into the finished dental bridge.

[0005] To be more specific, the tolerance deficit results in the centre of the various components ending up eccentric upon assembly. A guide pin is admittedly used which can facilitate centring, but the guide pin which has hitherto been used has a plane stop surface or contact surface which interacts with corresponding plane stop surfaces and guide edges of the respective component. Such a system gives a correct transfer vertically, but a certain error laterally since there is always a built-in play between the guide edge and guide bevel of the components.

[0006] It has also been proposed, as disclosed in US-A-4 708 654, which forms the preamble of Claim 1, to make conical surfaces interact in an impression system, i.e. to use a guide pin with conical guide surface which can interact with conical stop surfaces of the various components. Such a system should give a correct lateral positioning on account of the centring capacity of the guide pin, but it has hitherto required a new set of components with conical guide holes.

[0007] The object of this invention is to remedy the shortcomings and disadvantages which are found in the earlier impression methods and in so doing to compensate for sources of error in the impression method and in the fitting of the finished dental bridge in the mouth. According to the invention, this is achieved by the method as claimed being providing that part of the guide pin which interacts with the stop members of the guide holes of the respective impression component with a conical stop surface, while the stop members of the impression components form plane surfaces and guide edges.

[0008] By means of the conical stop surface, the centring capacity of the guide pin increases and at the same time the interacting plane surfaces and guide edges of the guide holes of the impression components mean, on the one hand, that the vertical precision is maintained and, on the other hand, that a certain desirable and controlled lateral play can be maintained, for example for the gold cylinder, compared with the situation where these surfaces would also have been conical in accordance with an earlier model.

[0009] In order further to improve the precision, the method also involves minimizing the play between distance member and impression top and also between impression top and distance dummy, while an intentional and adapted play is allowed between gold cylinder and distance member.

[0010] An exemplary embodiment of the invention is described hereinbelow with reference to the attached drawings, in which

Fig. 1 shows, diagrammatically, various stages during impression-taking in accordance with a known technique (prior art),

Fig. 2 shows corresponding stages using a method according to the invention,

Fig. 3 shows a model for calculating the cone angle of the guide pin, and

Fig. 4 illustrates the relation between the tolerance ranges of the various components.

[0011] Fig. 1a shows the first stage in the impression technique, namely the positioning of an impression top 1 on a distance member 2. The distance member is fit-

ted in a known manner on a securing element (not shown) by means of a distance screw 3. The impression top 1 is secured on the distance member 2 with the aid of a guide pin 4, and the impression top therefore has a continuous guide hole 5 for the guide pin. The diameter of the guide hole is slightly larger than the diameter of the guide pin. A stop 6 is arranged in the guide hole, with which stop 6 there interacts a flat stop part 7 of the guide pin. The guide pin is additionally provided with a lower, narrower, threaded part 8 which is screwed firmly into a corresponding threaded hole in the distance screw 3. The flat guide pin, when it is tightened, gives only a compressive force which acts on the component which is to be screwed firm. The direction of the compressive force is axial, which means that the component will not move in the radial direction. The guide pin with the flat stop surface does not therefore have any centring capacity with respect to the play which is always present between the guide pin and the guide hole. This play or clearance can amount to the order of 0.1 to 0.2 mm, and a corresponding error is already built into the impression system at this first stage.

[0012] Figure 1b shows stage 2 in which a distance dummy 9 is fitted on the impression top 1. The guide pin 4 is also used here for securing the two components to one another. On account of the unavoidable play between the guide pin and the guide hole in the impression top, a new error is added to the one already existing in the impression technique.

[0013] Figure 1c shows a further stage in the impression-taking, namely when the gold cylinder 10 is connected to the distance dummy 9. A further centring error is here added to the two earlier ones.

[0014] Figure 2 shows corresponding stages in the impression/model production, but using the new technique according to the invention. In this case too the impression components, i.e. impression top 1, distance dummy 9 and gold cylinder 10, are provided with stops 6 having plane surfaces and guide edges, i.e. a horizontal annular surface 6' and a cylindrical surface 6", while the guide pin has a conical stop surface 11 which interacts with the edge 6'" of the stop 6. As the guide pin is screwed firmly into the distance member or the distance dummy, this means that the contact force (P) will act at right angles with respect to the contact surface 11. The contact force can be divided up into two force components: one which acts in the axial direction (N) and one which acts in the radial direction (F). The radial force component can displace the component in this plane if cone angle and friction coefficient are favourable.

[0015] A model of how the cone angle α of the guide pin 4 can be calculated is shown in Fig. 3. In the figure, the contact surface 11 of the guide pin is assumed to interact with a body 12 which can be displaced along a plane 13. Just as the body begins to slide, it is affected by the friction force μN. Experiments have shown that the friction coefficient μ lies within the range $0.23 < \mu < 0.55$ depending on the material combination in the contact surface.

[0016] From Fig. 3 it follows that

$$F = \mu N$$

$$\tan \alpha = N/F$$

which yields

$$\tan \alpha = 1/\mu$$

for $\mu = 0.23$ it follows that $\alpha \leq 77°$ and $2\alpha \leq 154°$
for $\mu = 0.55$ it follows that $\alpha \leq 61°$ and $2\alpha \leq 122°$.

[0017] Twice the cone angle should therefore be smaller than 120° in order for the component to be able to be displaced. Twice the cone angle should expediently lie within the range $15° \leq 2\alpha \leq 90°$ since the friction coefficient just before the component begins to slide (start friction) is greater than the sliding friction. The lower limit of 15° is chosen so that the guide pin will not jam.

[0018] As a result of the centring capacity of the conical guide pin, the precision in the first three stages of the impression method is therefore increased. In the fourth and final stage, when the gold cylinder is placed on the distance member, a flat gold screw is used instead of the conical guide pin, since a certain play is desirable between gold cylinder and distance member (see below).

[0019] The tolerances of the components which are used in the impression system will be chosen with regard to two factors:

- the impression components will be able to perform their function in a satisfactory manner,
- it will be possible for the components to be manufactured at a moderate cost.

[0020] As regards the function of the components, the tolerance ranges for distance member, impression top, distance dummy and gold cylinder will be as "small" as possible. This is particularly important for the first three components, since "small" and correctly placed tolerance ranges result in a lower possible play between the components during the impression procedure.

[0021] Figure 4 illustrates, diagrammatically, tolerance ranges for the components, namely distance member (D), impression top (IT), distance dummy (DD) and gold cylinder (G). For the first three components mentioned, the tolerance ranges should lie edge to edge, as is shown in the figure, so that the "worst" tolerance deficit will be as small as possible and so that the components will always fit each other.

[0022] In contrast, the tolerance range as regards the gold cylinder (G) will be placed in such a way that there is always a certain play with respect to the distance member. This predetermined and intentional play will

allow a dental bridge to be fitted in the mouth cavity even if there is a certain error in relation to the positioning of the distance members in the mouth cavity. The intentional play between gold cylinder (G) and distance member (D) is preferably within the range of 0.05 - 0.2 mm.

[0023] The optimized tolerance, in combination with the guide pin formed with a conical stop surface, thus minimizes error in the lateral (xy) direction in the production of a model and bridge. Residual error in this direction is then compensated by an intentional and calculated play between gold cylinder and distance member in combination with a non-centring screw connection (gold cylinder/flat gold screw) when the construction is finally anchored in the patient's mouth.

Claims

1. Method for increasing the precision of an impression system for dental prostheses of the type which are permanently anchored in the jaw by means of one or more securing elements implanted in the jawbone and each provided with a distance member (2) whose upper part protrudes above the palatal arch and on which the finished dental prosthesis/dental bridge is then anchored via a so-called gold cylinder, the system including impression components in the form of impression tops (1) and distance dummies (9) with continuous guide holes (5) and stop members (6) for a guide pin (4) which, during fixing of the components, is guided through the respective guide hole and engages with the stop members (6) of the respective impression component, and that part of the guide pin (4) which interacts with the stop members (6) of the guide holes (5) of the respective impression component (1, 9) has a conical stop surface (11), characterized in that the conical guide pin interacts with stop members which form plane surfaces and guide edges (6', 6").

2. Method according to Patent Claim 1, characterized in that twice the cone angle $2(\alpha)$ of the stop surface (11) of the guide pin lies within the range of $15° \leq 2\alpha \leq 90°$.

3. Method according to Patent Claim 1, characterized in that the play of the guide edges is minimized between distance member (2) and impression top (1) and between impression top (1) and distance dummy (9), while an intentional and adapted play is present between gold cylinder and distance member (2).

4. Method according to Patent Claim 3, characterized in that the intentional play present between gold cylinder and distance member lies within the range of 0.05 - 0.2 mm.

5. Method according to Patent Claim 3, characterized in that the tolerance ranges for distance member (2), impression top (1) and distance dummy (9), in addition to being minimized, are placed edge to edge with each other, while the tolerance range of the gold cylinder is placed with the said adapted play in relation to the distance member (2).

Patentansprüche

1. Verfahren zum Verbessern der Präzision eines Abdrucksystems für Dentalprothesen des Typs, die im Kiefer permanent verankert werden mittels eines oder mehrerer Befestigungselemente, die im Kieferknochen implantiert sind und jeweils mit einem Distanzelement (2) versehen sind, dessen oberer Teil über den Gaumenbogen vorsteht und auf dem die fertige Zahnprothese/Zahnbrücke über einen sog. Goldzylinder verankert wird, wobei das System Abdruckkomponenten umfaßt in Form von Abdruckoberteilen (1) und Abstandselementattrappen (9) mit durchgehenden Führungslöchern (5) und Anschlagelementen (6) für einen Führungsstift (4), der beim Fixieren der Komponenten durch das jeweilige Führungsloch eingeführt wird und an den Anschlagelementen (6) der jeweiligen Abdruckkomponente anliegt, und wobei derjenige Teil des Führungsstiftes (4), der mit den Anschlagelementen (6) der Führungslöcher (5) der jeweiligen Adruckkomponente (1, 9)) zusammenwirkt, eine konische Anschlagfläche (11) hat,
dadurch **gekennzeichnet,** daß der konische Führungsstift mit Anschlagelementen zusammenwirkt, die ebene Oberflächen und Führungskanten (6', 6") bilden.

2. Verfahren nach Anspruch 1,
dadurch **gekennzeichnet,** daß der doppelte Konuswinkel $2(\alpha)$ der Anschlagfläche (11) des Führungsstiftes im Bereich von $15° \leq 2\alpha \leq 90°$ liegt.

3. Verfahren nach Anspruch 1,
dadurch **gekennzeichnet,** daß das Spiel der Führungskanten zwischen dem Abstandselement (2) und dem Abdruckoberteil (1) und zwischen dem Abdruckoberteil (1) und der Abstandselementattrappe (9) minimiert ist, während ein beabsichtigtes und geeignet gewähltes Spiel zwischen dem Goldzylinder und dem Abstandselement (2) vorhanden ist.

4. Verfahren nach Anspruch 3,
dadurch **gekennzeichnet,** daß das beabsichtigte Spiel zwischen dem Goldzylinder und dem Abstandselement im Bereich von 0,05 bis 0,2 mm liegt.

5. Verfahren nach Anspruch 3,

dadurch **gekennzeichnet,** daß die Toleranzbereiche für das Distanzelement (2), das Abdruckoberteil (1) und die Distanzelementattrappe (9) nicht nur minimiert sind, sondern auch lückenlos aneinander anschließen, während der Toleranzbereich des Goldzylinders mit dem genannten angepaßten Spiel relativ zu dem Distanzelement (2) liegt.

Revendications

1. Procédé d'augmentation de la précision d'un système d'empreinte pour prothèse dentaire, du type ancré de manière permanente dans la mâchoire par un ou plusieurs éléments de fixation implantés dans la mâchoire et ayant chacun un organe d'entretoise (2) dont la partie supérieure dépasse au-dessus de la voûte du palais et sur lequel est alors ancré la prothèse dentaire ou le bridge dentaire terminé par l'intermédiaire d'un "cylindre d'or", le système comprenant des éléments d'empreinte sous forme d'organes supérieurs d'empreinte (1) et d'organes factices d'entretoise (9) ayant des trous continus de guidage (5) et des organes d'arrêt (6) d'une broche de guidage (4) qui, pendant la fixation des éléments, est guidée dans le trou respectif de guidage et coopère avec les organes d'arrêt (6) de l'élément respectif d'empreinte, la partie de la broche de guidage (4) qui interagit avec les organes d'arrêt (6) des trous de guidage (5) dans l'élément respectif d'empreinte (1, 9) possédant une surface conique d'arrêt (11), caractérisé en ce que la broche conique de guidage interagit avec les organes d'arrêt qui forment des surfaces planes et des bords plans de guidage (6', 6").

2. Procédé selon la revendication 1, caractérisé en ce que le double de l'angle du cône $2(\alpha)$ de la surface d'arrêt (11) de la broche de guidage est tel que $15° \leq 2\alpha \leq 90°$.

3. Procédé selon la revendication 1, caractérisé en ce que le jeu des bords de guidage est réduit au minimum entre l'organe d'entretoise (2) et l'organe supérieur d'empreinte (1), et entre l'organe supérieur d'empreinte (1) et l'organe factice d'entretoise (9), alors qu'un jeu intentionnel et adapté est présent entre le cylindre d'or et l'organe d'entretoise (2).

4. Procédé selon la revendication 3, caractérisé en ce que le jeu intentionnel présent entre le cylindre d'or et l'organe d'entretoise est compris entre 0,05 et 0,2 mm.

5. Procédé selon la revendication 3, caractérisé en ce que les plages de tolérances de l'organe d' entretoise (2), de l'organe supérieur d'empreinte (1) et de l'organe factice d'entretoise (9) non seulement sont minimales mais sont encore placées bord à bord, la plage de tolérances du cylindre d'or étant disposée avec le jeu adapté par rapport à l'organe d'entretoise (2).

Fig. 1a

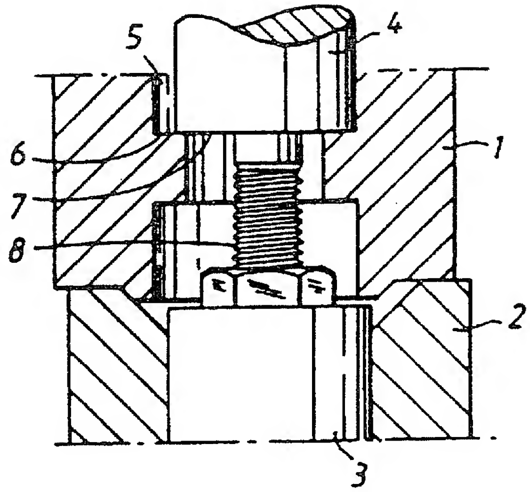

Fig. 1b

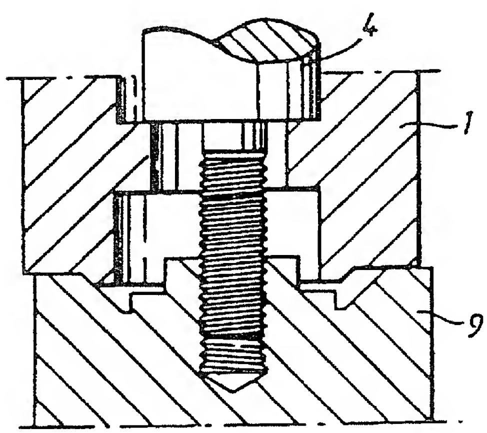

Fig. 1c

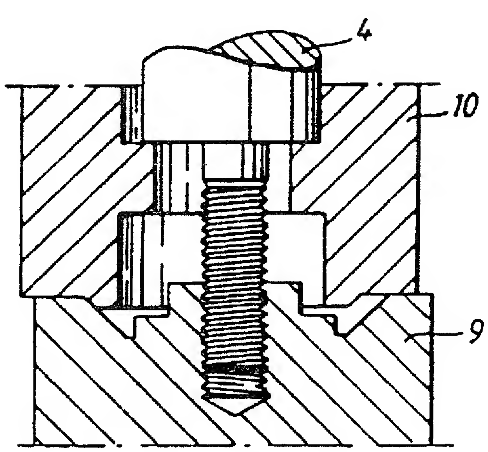

Fig. 2a

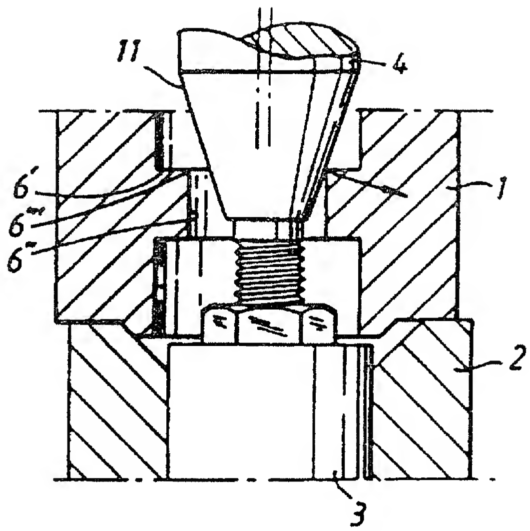

Fig. 2b

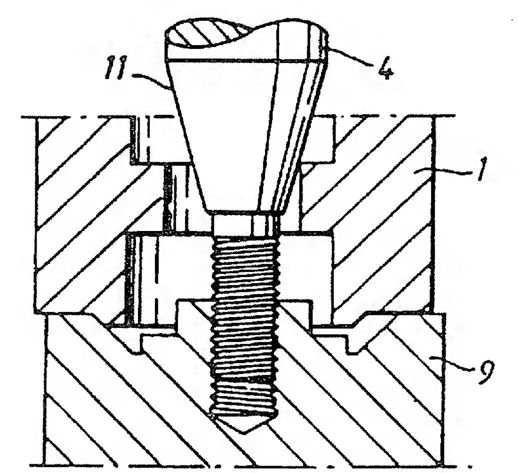

Fig. 2c

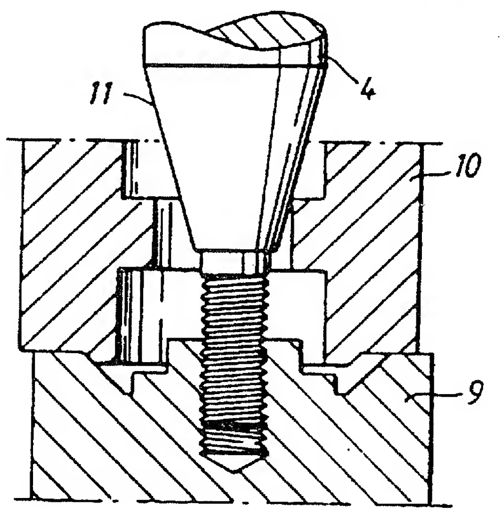

Fig. 3

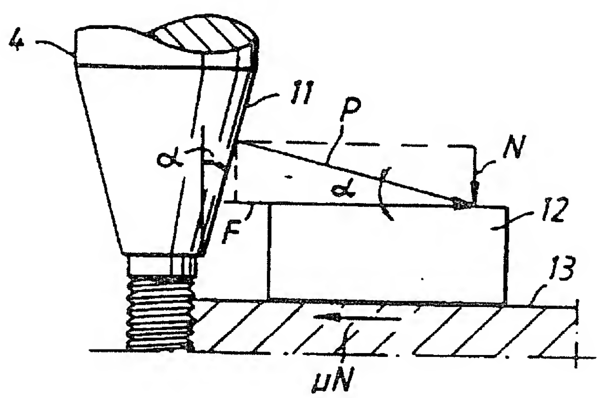

Fig. 4